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March 20 - 22, 2012
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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

The Atlantic Zone Monitoring Program (AZMP) was implemented in 1998 with the aim of collecting and analyzing the biological, chemical, and physical field data that are necessary to (1) characterize and understand the causes of oceanic variability at the seasonal, interannual, and decadal scales, (2) provide multidisciplinary data sets that can be used to establish relationships among the biological, chemical, and physical variables, and (3) provide adequate data to support the sound development of ocean activities. AZMP scientists meet annually to review the activities of the Program and assess business, operational and logistic issues that need regional/zonal intervention, or that must be brought to the attention of the DFO Atlantic Science Directors Committee. 2009 marked the 10th anniversary of ocean observation by AZMP. In March 2010 AZMP scientists initiated an effort to synthesize and integrate the oceanographic conditions observed in the Atlantic Zone since 2000, identify trends or changes, and provide a critical assessment of the information available. In 2012, they reconvened in Montreal from March 20 to 22 to discuss logistic and operational issues, review recent oceanographic conditions within the zone, update the plans for the integration and synthesis exercise, and finalize the workplan for the current year.

Compte rendu de la 14e revue par les pairs zonale du Programme de Monitorage de la Zone Atlantique (PMZA)

RÉSUMÉ

Le Programme de monitorage de la zone atlantique (PMZA) a été mis en œuvre en 1998 afin de recueillir sur le terrain et analyser les données biologiques, chimiques et physiques nécessaires pour : 1) caractériser et comprendre les causes de la variabilité océanique à des échelles saisonnières, interannuelles et décennales; 2) constituer des ensembles de données multidisciplinaires qui peuvent servir à établir des relations entre les variables biologiques, chimiques, et physiques et 3) fournir des données adéquates pour assurer le développement adéquat de projets en milieu marin. Les scientifiques du PMZA se réunissent annuellement pour revoir les activités du Programme et identifier les enjeux relatifs à ses opérations et à la logistique qui requièrent une intervention régionale/zonale ou qui doivent être portés à la connaissance du Comité des directeurs des sciences de la zone atlantique du MPO. Le PMZA a complété sa première décennie d'observations océaniques en 2009. En mars 2010, les scientifiques du Programme entreprirent de synthétiser et d'intégrer les conditions océanographiques observées dans la zone atlantique depuis 2000, d'identifier les tendances ou les changements survenus et d'effectuer une évaluation critique de l'information disponible. Ils se sont réunis à nouveau à Montréal du 20 au 22 mars 2012 pour revoir les enjeux logistiques et opérationnels, discuter des conditions océanographiques récentes dans la zone, évaluer la progression des efforts de synthèse et d'intégration et finaliser le plan de travail pour l'année en cours.

SESSION 1 - AZMP BUSINESS MEETING (RAPPORTEUR: B. CASAULT)

20 MARCH 2012

ACTION ITEMS FROM MARCH 2011 MEETING

Logistics Subcommittee (A. Gagné, J. Spry, G. Maillet)

The AZMP Logistics Subcommittee was tasked with the evaluation of the status of current laboratory instrumentation and field equipment for zonal operations. The following is the list of tasks and actions taken during the 2011–2012 period:

- Review and update the list of AZMP equipment needs and submit a revised list to the PMCC.

All regions have provided feedback regarding essential replacements of field monitoring gear and laboratory instrumentation critical to maintain current AZMP operations and emerging priorities. The compiled listing has been forwarded to the PMCC along with the logistics leads in each region. The priority field equipment and instrumentation required for continued operations of the AZMP include the following standard oceanographic equipment and instrumentation: i) CTD (conductivity-temperature-depth) systems with auxiliary bio-optical, biological, and chemical sensors; ii) CTD-Rosette/ADCP sampling systems for vertical profiling applications; iii) Niskin bottles for discrete-depth seawater collections; iv) plankton net collection systems; v) electromechanical winch/hydrowire for gear deployment operations; and vi) laboratory instrumentation for biological and chemical analyses.

- Evaluate what could be achieved through renewal with new equipment or through the upgrading of older equipment.

Although refurbishment is an option for consideration in some limited cases, the committee's recommendation is to procure new equipment since a significant portion of our field gear and laboratory instrumentation is currently well beyond its expected life cycle. One significant advantage of new acquisition is that it allows utilizing up-to-date hardware and associated software applications and provides the capability of backup systems in case of loss/failure during field missions.

- Review previous CPSNs (Lab Modernization, Monitoring Equipment) and recommend options to PMCC.

The Committee has reviewed previous CPSN's which are now referred to as Investment Summary Notes (ISN's). Essentially, CPSN's/ISN's are equipment listings under the above categories with detailed justification along with risk assessments. The committee would highlight the importance of the provision of the risk assessment to the AZMP (i.e. potential consequences of not replacing our equipment, what do we lose?).

- To facilitate the acquisition of equipment when funds become available: identify relevant National Master Standing Offers (NMSOs) currently available and NMSOs gaps, identify providers with whom NMSOs should be established and recommend new NMSOs as appropriate.

NMSO's are currently available from major scientific supply companies such as Fisher and VWR. SeaBird Electronics is one of the major suppliers of oceanographic equipment to DFO

but only has a Regional Individual Standing Offer (RISO) with the Bedford Institute of Oceanography (BIO) in place until Sep. 30, 2014. This RISO agreement does permit authority to be delegated outside of BIO to other regions (NAFC, MLI). Individual call-up limitation of 40K applies (similar to many NMSOs).

The committee's general recommendations are:

- To seek extension of the RISO available with BIO to elevate status to National Master Standing Offer (NMSO) in order to facilitate the acquisition of new oceanographic equipment across all DFO regions.
- To seek input from Finance Department and designated experts in procurement within DFO with respect to the above process.
- To seek an expression of interest with SeaBird Electronics for the development of NMSO status.The committee suggested that the most recent successes with procurement of new equipment (e.g. SBE-25 CTD, oxygen titration system and nutrient autoanalyzer – NAFC Region) have resulted from RISO/NMSOs which permit the use of year-end funds on very short notice. The committee also proposed the CCG Integrated Investment Planning Framework (http://www.ccg-gcc.gc.ca/home/publications/Integrated-Investment-Plan-2011-2016/Appendix-C) as a guide/model for the PMCC and Logistics Subcommittee for the development of ISNs.

Data Management Subcommittee (M. Ouellet, M. Kennedy, L. Devine)

The AZMP Data Management Subcommittee would like to have a period set aside at future meetings to discuss issues, activities and strategies. This yearly meeting is their only opportunity to meet face-to-face.

The terms of reference for the subcommittee need to be reviewed, but these are likely the main responsibilities:

- AZMP data flow: what data were collected; what is their current status.
- Quality control.
- Data access (BioChem [bottle and plankton], ISDM [bottle and CTD], Climate [CTD], ODMS [IML: CTD, bottle, plankton], VDC [materialized view of BioChem], AZMP website).
- Access to AZMP program documents, data products, bulletin (AZMP website).
- Data discovery: create metadata records for AZMP data.

The following is the list of tasks and actions taken during the 2011–2012 period:

- It was asked whether a script is available to chief scientists for producing the TESAC files. Such scripts currently exist at IML, BIO and NAFC. ISDM will compile a list of existing scripts/programs and make them available to scientists who currently do not have access to them.
    - M. Ouellet sent ISDM TESAC generation scripts and programs to a distribution list comprised of P. Galbraith, L. Devine, C. Lafleur at IML, J. Spry, J. Jackson, M. Kennedy at BIO, and D. Senciall and P. Stead at NAFC, and asked for the same from each institution. D. Senciall, C. Lafleur and J. Jackson shared their respective programs and scripts (with CC to all), and/or details on programs and scripts used. Using this info, M. Ouellet summarized the available scripts in the following table:

Institution	Input format	Ouput format	Name	Language	Platform
ISDM	IGOSS	ocproc	newtesacf.for	Fortran	openVMS
ISDM	OCPROC	BATHY/TESAC	proc_to_gts.for	Fortran	openVMS
IML	Matlab odf-structure	IGOSS	odf2igoss.m	Matlab	Windows/any
BIO	ODF	IGOSS	odf_igos.exe	java	Windows (with java JRE v1.6)
BIO	ODF	IGOSS	igoss.m	Matlab	any
NAFC	Nafc_y2k format or Seabird Inc. factory format with NAFC meta-data insert	BATHY/TESAC	process (multi purpose processing suite)	C (with lex and yacc)	Unix/Linux/windows (as a 32-bit console cmd)

Copies of BIO's and ISDM's programs were stored in a folder available internally at ISDM: X:\ISDM\OuelletM\azmp\gts_programs_repository. Anyone can request ISDM for these programs at any time. For IML and NAFC programs, please contact C. Lafleur and D. Senciall, respectively.

- Better formatted data are available and NetCDF could be made available. M. Ouellet will make NetCDF available at HQ.
  - NetCDF files for AZMP sections and stations currently available at ftp://ftp.meds-sdmm.dfo-mpo.gc.ca/pub/ODP/AZMP/
  - The NetCDF format currently used is multi-profile GADR NetCDF 2.1. The files are also registered on the IODE Ocean Data Portal. M. Ouellet is waiting for the finalization of a new format development under GTSPP for publishing those files on the AZMP website. DFO modellers have been made aware of the availability of these NetCDF files on the FTP server. The CSV file format will be revised with changes that were suggested by answers to the 2010/2011 survey, and the question of significant digits raised by Eugene at the meeting will be addressed to ensure that all significant digits of temperature, salinity and other variables are reported.
- It was decided that those calculating the anomalies contact one another and agree on how this will be done and document it for the next time this question arises (M. Ouellet to lead; participation of P. Galbraith, R. Pettipas, D. Hebert and E. Colbourne).
  - M. Ouellet drafted a tentative methodology to calculate anomalies based on previous correspondence during the drafting of the Bulletin's environmental review scorecard and sent it to P. Galbraith, R. Pettipas, D. Hebert and E. Colbourne (Feb 21 2012) for discussion and edition. M. Ouellet will re-send the email.
- Use of IML's Matlab quality control software.
  - IML provided Matlab scripts (CTD and bottle QC) to Maritimes and NL, and modified the bottle QC package for use in NL waters (provided appropriate land mask, bathymetry, t-s-sigT and nutrient climatologies); a test run by IML personnel with a NL dataset was successful, and NL was able to reproduce the results in-house.
  - Concerns with respect to data QC software were raised at the regional level (S. Bond) and national (ISDM) level (M. Ouellet). The latter suggesting a downgrading of QC code from currently having multiple procedures.
- A data manager should be identified from each region (no rep from NL).

- The NL region is facing data related issues since the region has no dedicated data manager and therefore data are not being loaded in databases until in-house personnel is in place. Data are being archived at present but not in standard format. P. Pepin reinforced that the hiring of a dedicated data manager is under the responsibility of the regional direction.
- Outside help from MAR region for data loading was provided in the past but is no longer a viable option.
- L. Devine has provided help to J. Craig and G. Maillet with respect to data QC. G. Maillet is currently performing QC of 2010/2011 CTD and 2011 bottle data from NL surveys.
- A major issue pending is the QC of backlogged data.

- A data flowchart must be available for consultation by all AZMP members (on the VDC) that will indicate, by region, what data were collected, whether the samples are analyzed, quality controlled, archived, and dates where applicable.
  - This table was provided by Québec region (http://vsnsbiovdctest.ent.dfo-mpo.ca/national/steering-committees/azmp/data-flow/data-status-quebec-region/view) but not yet by other regions.
  - M. Kennedy confirmed that work was undertaken in collaboration with J. Black (Population Ecology at BIO) to include statistics in such tables.
- IML to make Matlab BioChem load procedure available. No action; request repeated for 2012–2013.
  - NL formally requested Matlab codes from IML/BIO to be made available.
- Submission of AZMP data to US WDC-Oceanography. In progress.
  - Data QC is identified as a significant issue with respect to submitting data externally. NODC subjects all data it receives to its own QC procedures. Data not *a priori* QCed regionally or nationally (ISDM) are returned by NODC which further delays data availability from their website.
  - M. Ouellet reported on a data sharing initiative under the International Ocean Protocol in which data are networked between different countries in an effort to avoid duplication. The current model requires each participating country to set up its own data server which causes problems with DFO due to existing network security policies. A temporary solution currently in use is to copy data to a server located in Belgium. However, this solution is practically limited from the point of view of: i) uploading the data to the remote server, and ii) keeping the data up-to-date which requires frequent updates of the main server. The AZMP data (in NetCDF format) is currently being uploaded to the main server in Belgium although the process is not working smoothly.
  - M. Kennedy also briefly reported on another data sharing initiative in which AZMP data are being made available through the Ocean Biogeographic Information System (OBIS) data portal.
- A tutorial directed at AZMP users will be created on how to use the VDC.
  - A beginners guide was created in April 2011 http://vsnsbiovdctest.ent.dfo-mpo.ca/national/steering-committees/azmp/azmp-and-the-vdc.

- Concerns were raised regarding the visibility of the VDC on the web and consequently the accessibility of its content (e.g. the tutorial among other things) to potential users. It was suggested to add an URL link for the VDC on the AZMP main website.

The following items were discussed and will be addressed in the coming year:

- IML to make Matlab BioChem load procedure available. IML will modify their load procedures to suit NL's needs (starting with bottle; plankton loading will then be discussed). NL has indicated that they do not want to load non-QCed bottle data.
- Data status must be known by AZMP members. It is essential that these tables be compiled and available for consultation. If possible, an indication should be made of when outstanding data will become available.
- Data downloaded from AZMP sources must contain a numerical placeholder when no data is available (otherwise very difficult to load matrix with some programs).
- A tutorial should be made available on the VDC showing typical BioChem queries.
- M. Kennedy will make available a way to link BioChem species codes to WoRMS AphialD's to resolve taxonomic naming problems and provide a method of hierarchical taxon grouping.
- Data exchange with other organizations; need to consider the best way to do this.
- Should there be a formal report made by the DMSC at the yearly meetings? If so, what form should it take?
- Backlogged data must be archived.

Oceanographic Conditions

Climate indices

- The calculation of climate indices is not an obvious task and efforts are being invested in uniformizing the procedure for calculating these indices. An email was sent by M. Ouellet earlier describing the current calculation procedures and requesting inputs from selected collaborators. D. Hebert commented on issues with the current procedures on behalf of R. Pettipas.
- M. Ouellet is to resend an email seeking further inputs from AZMP collaborators.

Scorecards

- There was no significant progress on the development of composite indices aimed at calculating physical/biogeochemical anomalies. The NL methodology for zooplankton data using a GLM to fill in missing values was tested using abundance data from the Maritimes transects and the results showed agreement between the GLM and the geometric mean estimates.
- The GLM and the geometric mean estimates provide slightly different results with respect to their ability to detect interannual variability. This is however of lesser concern as the interest lies in detecting trends and regional patterns.
- The cancellation of surveys is identified as a significant issue with respect to the calculation of composite indices. Missing data bear a relatively small impact with respect

to our ability to detect trends but necessitate a more careful approach in the interpretation of interannual changes.

Observations and Modeling

Data format

- M. Ouellet reported on efforts that resulted in an improved data format for the data distributed in CSV files.
- Data in NetCDF format are now available although modifications are still needed to fully comply with NODC data structure standard.

Model indices

- A brief discussion took place regarding the calculation of indices from simulation model results. For the Québec and Maritimes regions, it was suggested that transport be extracted from the results of the OPA model implementation (D. Brickman) and river discharge be extracted from the results of the Gulf of St. Lawrence model (J. Chassé). For the NL region, it was suggested that transport be extracted from G. Han's model results and bottom temperature as well as other parameters from F. Davidson's model.
- Model indices are desirable as they are relatively easy to extract from model results and they provide useful information to aid in the analysis of the biological observations as an example. Caution must be exercised in the use of model indices due to the accuracy inherited from the model they are derived from. Their use is justified on the basis of the model's ability to provide trends.
- For the time being, it is suggested that model indices be provided to support regional synthesis activities without however being directly included in research documents.

AZMP ACTIVITY REPORTS

Integrated Science and Data Management (ISDM) (*M. Ouellet)*

The status of real-time (i.e. dissemination lag of ~30 days) and delayed-mode data processing was presented. TESAC data for the transects and most fixed stations, with the exception of Station 27, were generally sent on time for real-time processing. CTD data submission for real-time processing was good for most fixed stations with the exception of Station 27, but significantly lower for bottle data. CTD and bottle data submission for the transects was low at about 25% of transects total occupations. By ship, TESAC data submission delays were mostly associated with Pandalus, Needler, Shamook and Creed surveys.

CTD, bottle and BATFISH data from a total of 96 surveys were received and processed in the ISDM archives in delayed-mode during the period of March 2011 to Feb 2012. Over the same period, data from older and recent surveys as well as data resubmissions were received but not yet processed in the ISDM archives. Missing CTD data for delayed-mode processing was relatively low for most fixed stations, with the exception of Station 27 with all 2010 and 2011 data still unavailable. Similarly, missing CTD data was low for most transects, with the exception of Newfoundland and Labrador transects with all 2011 data still unavailable. Biochem bottle data for the transects and the fixed stations have been integrated into the ISDM archives as part of delayed-mode processing activities.

Improvements to the AZMP website were implemented in addition to the regular updates routinely performed (i.e. meteorological, water levels and hydrological data, climate indices, publications and documents updates). A RSS feed is now available to communicate changes and additions made to the website, with the browser version still being maintained. An integrated inventory for transects data is now available allowing single level access to CTD and bottle data for any given transect. The display of hydrographic data is now accompanied with a warning notice advising users on the use of low resolution TESAC data for plotting purposes with eventual update to full resolution CTD data once available. The Gulf Center was added to the transect's hydrographic data inventory. The inventory of hydrographic data for both the fixed stations and the transects is now presented in a scorecard-like format displaying data availability on a survey basis.

In summary, there was a net improvement in the timely submission of TESAC data in 2011 compared to the previous year. With respect to missing data, CTD data for 2010 and 2011 from the Newfoundland and Labrador region are yet to be submitted and processed. Improvements and additions made to the AZMP website provide accrued completeness of the data set and easier access to the data.

Tasks for 2012 are to include: the fixing of date/time mismatches between the different data types (CTD/bottle/TESAC); the fixing of data synchronization problems with the BIO Climate database; the replacement of erroneous historical data; the migration of bottle archives to the Biochem database; and the data format conversion to NetCDF. The issue of resolution (significant digits) of deep water temperature data was raised and is to be addressed in the short term requiring modification of the original data processing codes.

Newfoundland and Labrador Region (*E. Colbourne)*

A total of 19 complete occupations were achieved at Station 27 along with 40 (37/3) vertical CTD/XBT profiles in 2011. CTD/XBT sampling took place in every month of 2011. Full sampling occurred in nine of twelve months with gaps in January (partial sampling but including zooplankton), and February and March (no biological data collected). The lack of winter sampling at Station 27 is due to the lack of adequate vessels for winter sampling.

The 2011 seasonal oceanographic surveys resulted in poor spatial coverage during spring but good coverage during summer and fall. Sampling during the spring survey occurred over only five days (April 26th to May 2nd) due to ship (Teleost) related issues. Spatial coverage during the spring survey consisted in the Southeast Grand Bank and part of the Flemish Cap transects. The summer survey took place from July 8th to 25th with occupations over five transects including Flemish Cap, Bonavista, Seal Island, Makkovik Bank and Nain Bank. Ship (Teleost) related issues resulted in the loss of the White Bay transect during the summer survey. The fall survey took place from November 20th to December 10th with occupations over six transects including Flemish Cap, Bonavista, Seal Island, Southeast Grand Bank, Southwest St. Pierre Bank and Southeast St. Pierre Bank. Equipment failure, ship related issues and personnel shortage were identified as significant issues during the 2011 seasonal oceanographic surveys.

Complementary programs also contributed extensive CTD/XBT coverage in 2011. These programs included the multi-species spring (591 profiles in NAFO Divisions 3P and 3LNO) and fall (592 profiles in NAFO Divisions 2J and 3KLNO) bottom trawl surveys, single-species surveys, MUN Marine Institute occupations (2) of Station 27, and the inshore Long-Term Temperature Monitoring Program.

Processing of 2011 biochemical samples is nearing completion (nutrients, zooplankton) or completed (chlorophyll). However, phytoplankton community composition has yet to be completed. CTD low resolution data for all missions have been submitted as of January 31, 2012, and high resolution data are to follow. Discrete bottle data have not yet been submitted to ISDM and only limited archived data have been entered into BioChem.

The Newfoundland and Labrador Region is facing budgetary issues as the AZMP is on fixed income and subject to continued funding pressures such as an increasing cost of operation and maintenance (e.g. zooplankton analysis now representing about one third of AZMP budget), inflation, increase in sampling coverage and a 10% branch tax on the overall budget. The region is also faced with other issues of more general nature such as: i) lack of vessels availability for winter sampling; ii) shortage of staff; iii) acquisition of new equipment (with need for nutrients autoanalyzer, dissolved oxygen/titration system, and sealogger CDT); and iv) absence of designated data management personnel.

Québec Region *(L. Devine)*

Sampling at the Québec fixed stations in 2011 consisted in 19 occupations at Rimouski and 7 occupations at each Anticosti Gyre (AG) and Gaspé Current (GC) stations. Sampling at Rimouski took place from early April to early October. Full sampling (i.e. CTD, bottles and vertical net tows) took place at 6 of the 7 AG and GC occupations. Of the 6 full sampling occupations at AG and GC, two occurred during dedicated outings (Feb), one occurred during the winter helicopter survey (Mar), and three took place during each the spring (Jun) and fall (Nov) seasonal oceanographic surveys as well as the summer groundfish survey (Aug). Poor coverage of AG and GC stations resulted in significant data gaps at these stations.

The 2011 Québec seasonal oceanographic surveys resulted in good coverage during spring and fall. The spring survey took place from June 1st to 20th with full sampling at each of the 46 stations occupation. The fall survey took place from November 1st to 13th with a total of 46/42 rosettes/vertical net tows sampling.

Analysis of the fixed stations (AG, GC, Rimouski) samples has been completed for chlorophyll, nutrients, phytoplankton and zooplankton. Sample analysis from the spring and fall oceanographic surveys has been completed for chlorophyll, nutrients and zooplankton but not for phytoplankton.

Complementary programs also contributed extensive physical/biological coverage in 2011. The mackerel egg survey took place from June 1st to 21st with a total of 61 CTD casts, 34 rosette casts and 64 vertical net tows. The summer groundfish survey in the Gulf took place in August with a total 100 CTD casts, 47 rosette casts and 64 vertical net tows. The winter helicopter survey took place from March 8th to 17th with a total of 93 stations occupation (200-0m CTD cast and nutrient surface water sample). Contributions from other complementary programs consisted in: toxic algae monitoring program (partial sampling from July to October); the ongoing Long-Term Temperature Monitoring Program (24 stations with surface/bottom temperature from May to October), shipboard thermosalinograph and oceanographic buoys. The zooplankton biomass survey did not take place in 2011.

A full list of the personnel involved in the Québec AZMP activities was presented. The main challenge for 2012 is to improve the consistency of the GA and CG dataset by increasing sampling frequency at these stations. To this end, the deployment of Seahorse moorings would be valuable for both GA and CG, as well as Northeastern Gulf stations.

Maritimes Region (*J. Spry)*

Sampling at the Maritimes fixed stations in 2011 consisted in 21 occupations at Station 2, 12 occupations at Prince 5, and 8 occupations at Shediac Valley (shared between BIO [5] and IML [3]). Shediac Valley station remained a logistical challenge in 2011 resulting in sampling being deferred until late May and a lack of overlap with other sampling activities (e.g. IML physical sampling by P. Galbraith). Problems at Prince 5 also raised concerns with respect to the continued sampling at that station in the future.

The 2011 Maritimes seasonal oceanographic surveys resulted in good coverage during spring and fall. The spring survey took place from April 7th to 23th with a total of 84/67 hydrographic/plankton samples. The fall survey took place from September 24th to October 14th with a total of 66/48 hydrographic/plankton samples. A new feature of the 2011 seasonal oceanographic surveys was the sampling of the Sydney Bight transect, which was initiated during the fall survey.

Complementary programs also contributed extensive physical/biological coverage in 2011. The winter groundfish survey on Georges Bank took place from February 5th to March 14th with a total of 50/10 hydrographic/plankton samples. The summer groundfish survey on the Scotian Shelf took place from July 5th to August 8th with a total of 264/37 hydrographic/plankton samples. The fall groundfish survey in the Southern Gulf of St. Lawrence took place from September 12th to October 2nd with a total of 138/16 hydrographic/plankton samples despite cuts from the Gulf region. For the first time, the spring groundfish survey on the Eastern Scotian Shelf was cancelled in 2011.

The AZOMP also contributed physical/biological coverage in 2011. The Labrador Sea survey took place between May 8th and May 28th with a total of 56/43 hydrographic/plankton samplings in the Labrador Sea and a total of 16/10 hydrographic/plankton samplings on the extended Halifax line.

Contributions from other complementary programs consisted in: Continuous Plankton Recorder with full coverage of the shelf region; BIONESS krill survey done during the shelf missions; July deployment of the Carioca buoy by Dalhousie University; April deployment of a SeaHorse mooring; ongoing weekly sampling in Bedford Basin; and ongoing Long-Term Temperature Monitoring Program. Two new initiatives were introduced in 2011: the Bras d'Or Lakes and the Enhanced Bedford Basin monitoring programs. On the other hand, two programs were not carried out in 2011: the Moving Vessel Profiler shelf tows and the Canadian Wildlife Service sea bird surveys.

Processing of the core samples for 2011 has been completed. Sample analysis from the Shediac Valley station was relegated to IML. Continued efforts are directed toward the processing of backlogged samples and the Gully BIONESS samples.

The Maritimes region operated within a $100K budget for 2011, of which $80K was provided by National Headquarters and $20K was recovered from taxes on other regional budgets. In addition, the cost of the CPR program totaled $127K in 2011 which was assumed by National Headquarters ($80K for AZMP A-base and $15K for core non-research activities) and IGS ($32K).

Equipment acquisition in 2011 consisted in a dissolved oxygen titration system for use on AZMP shelf missions. A second oxygen titration system is recommended for use in overlapping

missions and to serve as backup system. The region is also faced with issues of more general nature including: i) lack of vessels availability; ii) equipment maintenance and upgrading.

Next fiscal year will bring significant challenges due to: i) anticipated reductions in operating funds following the departmental strategic review and strategic operational review with potential impacts on regional monitoring programs, and ii) reduced vessel availability (Hudson set to be out of service until late July 2012) with potential impacts on the spring oceanographic survey, the Labrador Sea survey, and the fall groundfish survey in the Southern Gulf of St. Lawrence.

Other issues raised

- Fixed station Shediac
  - Two different positions are currently being sampled. A single position should be decided upon and used.
  - IML is now doing the processing/QC of the CTD profiles and QC of the bottle data. Need to coordinate forwarding of files (J Spry, L Devine).
  - J. Spry wondered if plankton (phyto and zoo) from Shediac shouldn't be analyzed at IML since IML is now doing the interpretation of this fixed station. That would mean that all Gulf fixed stations would have a coherent treatment. Should funds be transferred to cover the additional analysis costs? (maybe the small number of samples involved doesn't warrant this).
- Nutrient analysis team at IML feels it would be worthwhile for the logistics subcommittee to review analysis methods used among the AZMP regions. In this way, users of AZMP data would be assured that methods have not diverged since the beginning of the program and that all analyses are comparable.

SESSION 2

21 MARCH 2012

REVIEW OF ENVIRONMENTAL CONDITIONS IN THE NORTHWEST ATLANTIC (RAPPORTEURS: C. CAVERHILL AND L. DEVINE, * : PRESENTER)

Physical Oceanographic Conditions on the Newfoundland and Labrador Shelves during 2011

E.B. Colbourne, J. Craig, C. Fitzpatrick, D. Senciall, P. Stead, and W. Bailey*

Abstract

The North Atlantic Oscillation index, a key indicator of climate conditions on the Newfoundland and Labrador Shelf, after reaching a record low in 2010, remained in the negative phase at 1.2 standard deviation (SD) below normal and as a result, Arctic air outflow to the Northwest Atlantic remained weak in most areas in 2011. Annual air temperatures remained above normal at Labrador 0.7 SD (0.9°C at Cartwright) and Newfoundland 0.6 SD (0.5°C at St. John's) but experienced a significant decrease over the record highs of 2010. The annual sea-ice extent on the NL Shelf remained below normal for the 16th consecutive year, reaching a record low in 2011. As a result of these and other factors, local water temperatures on the Newfoundland and Labrador Shelf remained above normal, setting new record highs in some areas. Salinities on

the NL Shelf were lower than normal throughout most of the 1990s, increased to above normal during most of the past decade but decreased to fresher-than-normal conditions in many areas from 2009–2011. At a standard monitoring site off eastern Newfoundland (Station 27), the depth-averaged annual water temperature increased to a record high in 2011 at 3 SD above the long-term mean. Annual surface temperatures at Station 27 were above normal by 0.6 SD (0.4°C) while bottom temperatures (176 m) were at a record high at 3.4 SD (1.3°C) above normal. The annual depth-averaged salinities at Station 27 were below normal for the 3rd consecutive year. The area of the cold intermediate layer (CIL) water mass with temperatures < 0°C on the eastern Newfoundland Shelf (Bonavista Section) during 2011 was at a record low value at 2 SD below normal, implying warm conditions, while off southern Labrador it was the 4th lowest at 1.5 SD below normal. On the Grand Bank, the CIL was the second lowest on record. Average temperature conditions along sections off eastern Newfoundland and southern Labrador were above normal while salinities were generally below normal. Spring bottom temperatures in NAFO Divs. 3Ps and 3LNO during 2011 were above normal by up to 1–2°C with no < 0°C found near the bottom. The gridded average bottom temperature across the 3Ps–3LNO region was at a record high. During the fall, bottom temperatures in 2J and 3K were at record high values, at 2 and 2.7 SD above normal, respectively, and in 3LNO they were 1.8 SD above normal. Generally, bottom temperatures were about 1–2°C above normal in most regions, with very limited areas of the bottom covered by < 0°C water. The volume of CIL (< 0°C) water on the NL shelf during the fall was below normal (4th lowest since 1980) for the 17th consecutive year. A composite climate index derived from 27 meteorological, ice, and ocean temperature and salinity time series show a peak in 2006, a declining trend in 2007–09, and a sharp increase in 2010 and 2011 to the 2nd and 4th highest respectively, indicating warmer-than-normal conditions throughout the region.

Discussion

It was noted that ship time was lost during the year, and one participant wanted to know the effect that would have on calculations of the annual conditions. The speaker pointed out that sampling time was offered during another mission, so that the missed areas were occupied. The timing was not quite the same as usual, but the impact should not be too important. Another participant noted that the recent colder summer/spring conditions are similar to conditions in the early 1990s. It was noted that the summer salinity was higher than usual because a smaller spring pulse of freshwater led to high salinities in August.

Biogeochemical Conditions on the Newfoundland and Labrador Shelves During 2011

*G. Maillet and P. Pepin**

Abstract

On average, surface inventories of nitrate were generally higher during the first half of the 1999–2011 period whereas there was a general decline in bottom inventories. Silicate inventories demonstrated a similar pattern of change although the decline during the second half of the decade was not as marked as for nitrates. Phytoplankton standing stocks are highly variable from year-to-year but were generally low in 2011. Satellite imagery indicates a high degree of coherence in the interannual variations in the timing and magnitude of spring phytoplankton bloom. After a period with progressively earlier blooms, conditions in 2011 were near normal in the northern part of the region and late in the south. Zooplankton abundance has shown a general increase during the decade, with some taxa (e.g., *Calanus finmarchicus*, *Oithona atlantica*, *Centropages*, *Metridia longa*) having consistent trends whereas other taxa

are more variable. Changes in community composition and interannual variations in estimated abundance appear to be the result of variations in movement of water masses, with different mechanisms acting on the Newfoundland Shelf and Grand Banks. There have been some noticeable changes in the phenology and life history cycles of *Calanus finmarchicus* and *Pseudocalanus* spp. measured at Station 27, but the generality and consequences of these changes need further exploration.

Discussion

A participant remarked that Station 27 often shows conditions quite different from the rest of the transect and the wondered if Stn 27 should not be used for near-shore comparisons; the speaker agreed with this observation. A question was raised about the analysis showing coldwater species being present on the Grand Banks. It was explained that those species falling near the origin of the PC graphic had only weak linkages. Another participant noted the relationship between the arctic species and the warming arctic outflow and wondered why there were more arctic species even during the warming period. The speaker replied that there were indeed more arctic species, but that they were present in the cold, near-shore waters. The speaker said that this had to be looked at more carefully, and added that it would be interesting to create functional groups to explore this in a more general fashion. It was noted that the synthesis work will help reveal overall spatial trends. One participant thought it would be interesting to look at how salinity is related to species abundances, rather than just focusing on temperature. It was felt that this would be an interesting idea to pursue.

Physical, Chemical and Biological Conditions in the Labrador Sea in 2011

B. Greenan

Abstract

The Arctic Oscillation (AO) and North Atlantic Oscillation (NAO) indices for the 2010 Jan-Feb-Mar (JFM) period were record lows in the time series going back to 1950. However, these indices were slightly positive in the winter of 2011. The NCEP reanalysis of surface air temperature for this period indicated warmer than normal conditions with an anomaly of 3-6°C in the Labrador Sea during the winter period. The anomalies were smaller for the spring and summer periods, but were again observed to be greater than 4°C (centered in the Foxe Basin area) in the fall period. Sea surface temperature (SST) anomalies were also positive in 2011 reaching values of greater than 4°C in the winter period. Labrador Shelf ice extent was below normal in Jan-Mar 2011 (reference period: 1979-2000). .Sea ice conditions on the southern Labrador/Newfoundland shelf were well below normal in the winter 2011.

The annual AZOMP survey of the AR7W Line in the Labrador Sea took place on CCGS Hudson during the period of 6-29 May 2011. This survey also included sampling of the Extended Halifax Line (XHL) to monitor variability on the Scotian Rise in the deep western boundary flows of the NW Atlantic and to obtain additional information on oceanographic and lower-trophic-level variability of the Slope Water affecting the Scotian and adjacent shelves.

Physical oceanography measurements along AR7W indicate that the winter convection in the central basin of the Labrador Sea was very limited in 2011 due to the above normal air temperatures in the winter period. This was similar to the result observed in 2010. The lack of winter convection was also confirmed from Argo drifter profiles in the Labrador Sea during the winter 2011. Composite time series were presented using ship and Argo temperature and salinity data for the period 1930-present. The depth-averaged temperature anomaly for the

range 20-2000 m demonstrates that the anomaly has been rising sharply since the mid-1990s and is now at the highest in the observed record. The salinity anomaly for this depth range shows trends similar to that observed in the temperature record.

Total inorganic carbon (TIC) and pH in the 150–500 m depth range for stations in the central part of the Labrador Basin has been monitored over the period 1996–2010. TIC shows an upward trend ($r^2 = 0.77$) during this period, while pH has decreased ($r^2 = 0.67$). The sharp change in the trends for these two parameters does not seem to have an obvious explanation. The analysis has been re-checked for these measurements and it confirms that the procedures were correctly followed.

Systematic biological measurements have been made along the AR7/W line since 1994 and include major components of the lower trophic level (bacteria, phytoplankton and zooplankton abundance or biomass) metabolic rates (bacterial and phytoplankton productivity and respiration on occasion) and total biogenic carbon. All biological components exhibit high interannual variability.

Generally, the spring time values (i.e. sampled on AZOMP surveys) of chlorophyll, picophytoplankton, nanophytoplankton, and bacteria in the upper 100 meter of the water column have shown only weak, or no trends over the time series. An exception is on the Greenland Shelf/Slope where, since 2007, the bulk of phytoplankton biomass (i.e. chlorophyll a) has been increasing, but the abundance of the smallest cells (i.e. picoalgae and bacteria) has been decreasing. On an annual average basis (i.e. all months considered), there is no evident directional multiannual trend in ocean colour, but the time series is relatively short. On an annual average basis (i.e. all months considered), SST anomalies were negative in the early part of the time series. Since 2003, anomalies have been generally positive, but conditions are near normal in the most recent years.

The total abundance of the dominant mesozooplankton species, *Calanus finmarchicus*, was much higher on the Labrador Shelf in May 2011 than it had been in any of the previous years during which sampling was in late May. This was probably related to the fact that there was relatively little ice there in 2011 compared with previous years, so that the spring bloom had probably started earlier than usual, which would have advanced the timing of reproduction and development of *C. finmarchicus*. Thus, by late May large numbers of young stages had accumulated, which dominated the shelf populations.

Total abundances of *C. finmarchicus* in the Central and Eastern regions of the Labrador Sea were similar to those seen in previous years and in the Central Labrador Sea, the *C. finmarchicus* Population Development Index (i.e. percent young stages/all stages) was relatively high. This suggests that reproduction and development started relatively early. Similarly high values have only been seen since 2006, since when temperatures have been relatively high and spring blooms have been starting relatively early. At the time of writing, the satellite data used to estimate the time when the chlorophyll concentration reached a critical threshold was not available but the expectation is that the shift to early bloom dates that started in the early-mid 2000s is continuing.

The observation that an earlier start leads to high total *C. finmarchicus* abundance on the Labrador Shelf, but not in the Central Labrador Sea, suggests that mortality rates for eggs and nauplii are much higher in the central region.

Discussion

The speaker stated that the decrease in TIC in 2011 is difficult to explain. This could be due to an instrument malfunction; however, this was double-checked and there is no reason to believe that the result is not a valid result. One participant suggested that ice breakup might be a better index than SST to explain early onset of the phytoplankton bloom. The speaker pointed out that this is mid Labrador Sea which is not affected by sea ice as much as the shelf. Also, the SST anomaly is based on Spring (AMJ), which did not show significant changes such as those seen in the winter months.

A participant asked what signal is indicated by excess phosphate? The speaker explained that since Pacific water contains more phosphate than Atlantic water, excess phosphate would indicate transport of Pacific water through the Arctic into the Labrador Sea and serve as a marker for increased Arctic outflow.

Physical Oceanographic Conditions in the Gulf of St. Lawrence in 2011

P. Galbraith

Abstract

Air temperatures were above normal in winter (+1.7°C, +0.9 SD) as well as overall in 2011 (+0.7°C, +0.7 SD). The annual average runoff measured at Québec City was above normal overall in 2011 (+1.4 SD), seventh highest since 1955, with May having the fourth largest monthly runoff since 1955. Near-surface water temperatures were above normal in winter and typically normal for the remainder of the year until November, when they were above normal. Maximum sea-ice volume within the Gulf was 14 km^3, close to the record low of 11 km^3 recorded a year earlier, and consistent with the above-normal mixed layer temperatures. The duration of the 2010–11 ice season was much shorter than normal, beginning later than normal and consistent with very warm January air temperatures. No ice was exported onto the Scotian Shelf. Winter inflow of cold and saline water from the Labrador Shelf occupied the Mécatina Trough over the entire water column in winter 2011. Its volume was above normal in March 2011, at 2200 km^3 (+0.5 SD), and the percentage of cold water it represented was high, at 29% (+1.5 SD). The winter cold mixed layer volume (T < 0°C) in the Gulf, excluding the Estuary, was 13 300 km^3. While this matches the lowest volume recorded since 1996, it still corresponded to 40% of the total water volume of the Gulf. However, it was very warm, on average about 0.5 to 1°C above the freezing point. This is the second time in 16 years of winter surveys that such high temperatures were recorded. The cold intermediate layer (CIL) index for summer 2011 was +0.17°C, similar to observations in 2006, the warmest since 1983. On the Magdalen Shallows, none of the bottom area was covered by water with temperatures < 0°C in September 2010, similar to conditions in 2005, 2006, 2007, 2009, and 2010. In other regions of the Gulf, very few areas had bottom temperatures below 0°C. Regional patterns of the August and September CIL show that the layers for T < 1°C and < 0°C were much thinner in most parts of the Gulf in 2011 than in 2010 and had a generally higher core temperature everywhere. Conditions in March 2011 were characterized by a thin and warm mixed layer. The CIL remained below normal in thickness and above normal in minimum temperature throughout the remainder of the year, especially in the Estuary and Central Gulf. The deep waters in the Estuary were colder and fresher than normal in 2011. Very warm and saline waters occupied Cabot Strait all year at 250 m, the depth of the temperature maximum. Gulf-wide average temperatures were above normal at 150 m and normal at 200 to 300 m, and salinity averages were normal from 150 to 250 m and above normal at 300 m. Temperature at 300 m increased significantly overall (by 1.3 SD). At Cabot Strait, the 300 m temperature anomaly is positive by

1.2 SD; the highest since 1994. Salinity at 200 m and 300 m increased overall by 0.9 and 2.4 SD respectively, but increased at Cabot Strait to reach +1.2 SD at 200 m and +1.5 SD at 300 m, the latter being a high since 1986. Salinities in the central Gulf changed from -1.6 SD in 2010 to +1.2 SD in 2011, a large increase of 2.8 SD. The 300 m waters of the Estuary were expected to cool between 2010 and 2011 and instead they warmed slightly. The warm anomaly present since 2010 at Cabot Strait should progress up the channel towards the Estuary in the next two years. By November, the surface mixed layer was anomalously thick but more importantly very warm, warmer in fact than that observed during fall 2010, which were preconditions of the low ice cover of winter 2011.

Discussion:

none.

Biogeochemical Conditions in the Gulf of St. Lawrence in 2011

M. Starr and M. Harvey**

Abstract

(M. Harvey) Sufficient data now exist from AZMP observations (12 years) to document recurring spatial and temporal patterns in zooplankton properties of the St. Lawrence marine system (SLMS). Although many of the properties in 2009, 2010, and 2011 were similar to observations from previous years, a number of differences are noteworthy. Zooplankton biomass, abundance, and community composition in the SLMS are characterized by high spatial and temporal variability. Clear seasonal variability patterns are evident at the fixed stations and also in the spring and fall AZMP transects data.

There were several notable features in 2009–2011 at the four SLMS fixed stations:

- The zooplankton biomass was lower than the long-term averages at AG in 2009 and 2011, GC in 2011, and SV in 2009, 2010, and 2011 during June, July, and August.
- There was no apparent change in the copepod community structure in 2009–2011 at any fixed station.
- In terms of interregional variations in the mean abundances of copepods sampled from April–November (1999–2011; 2005–2011 at RS), 10% were sampled in the Lower St. Lawrence Estuary (RS), 23% and 21% in the northwest GSL (GC and AG), and 46% in the western southern GSL (SV).

For the SLMS transects:

- The abundances of three small copepod species (*Oncaea* spp., *Oithona* spp., and *Pseudocalanus* spp.) tended to increase through the time series in both June and November, with *Oithona* spp. being the dominant small copepod group for both periods.
- The interannual June abundance of the large copepod species (*Euchaeta* spp., *C. hyperboreus*, *C. glacialis*, *C. finmarchicus*, and *Metridia* spp.) increased from 2001 to 2006 or 2007 followed by variable decreases thereafter.
- There was no marked interannual change in abundance for any species in November except for *C. finmarchicus*, where abundance decreased after 2004.

Discussion

Comments for M Starr: it was noted that there were changes in the 2010–2011 nutrient levels concomitant to water mass changes, and it was proposed that this was due to mixing issues. Deep nutrient inventories throughout the region were also low throughout the year.

Comments for M Harvey: a participant noted that high concentrations of pteropods—which had been noted at one GSL fixed station—were also noted at the Halifax 2 station. The participant wondered if there was a connection. In addition, she wondered if the increase in *Oncaea* was associated with increases in larvaceans, since the former feed on larvacean houses. The participant went on to comment that there was very little coverage at the Anticosti Gyre and Gaspé Current stations in 2011, but that it was shown in the first part of the talk (M Starr) that there was good agreement between what happened at the Rimouski Station (high sampling density from April through October) and the conditions at the AG and GC stations. It was questioned whether the same is true for zooplankton indices. M Harvey will look into this question.

Physical Oceanographic and Meteorological Conditions on the Scotian Shelf and in the Gulf of Maine during 2011

D. Hebert, R. Pettipas and B. Petrie*

Abstract

In this presentation, several indices for the Maritimes Region were included. There has been a long-term increase in air temperature over the whole region. While the rate of increase varied over the whole region, fluctuations were coherent over the region. For the second year in a row, there was no ice on the Scotian Shelf. The North Atlantic Oscillation (NAO) was low for the second year while last year's NAO was the lowest value on record. As of January 2012, there is no evidence of a decrease in bottom water temperatures in Emerald Basin as normally expected for low NAO years. In the late 1990's and the 2000's, high interannual variability in bottom temperatures and cold intermediate layer volume was observed. This variability appears to be occurring in the western Scotian Shelf region. Stratification on the Scotian Shelf has been increasing over the last 50 years. This increase is mainly due to a freshening of the surface layer. Finally, the new source of data for the Halifax Line from the Ocean Tracking Networking glider was presented.

Discussion

One participant asked the cost of a glider. The speaker replied that a glider with no added equipment costs $70k. The big cost comes with running the glider. It takes several person years to run one or several gliders. One common problem that has been encountered with operating gliders is giving them too many waypoints. They can get stuck if there is a current that they have to try to overcome and cannot. It was asked who receives and decodes the signals from the glider. The speaker noted that there are two ways this can be done: one is to have a share-point area where data are received and stored, another way is to email out the data. People from Dal receive data by email every 6 hours, but anyone can ask to be added to the distribution list. Dal is trying to figure out how best to serve the data; for AZMP use, one possible suggestion is to put a subset of the data into the Climate database. Several participants felt that this was not the solution; the glider data would be better treated in the way Argo data are, through an international program with common infrastructure. At this time, NOAA and NSF are hoping to develop national facilities but these platforms still require significant

individual monitoring. Gliders are still considered experimental. Dal is working with Rutgers to have a common format. Richard Davis in John Cullen's group at Dal plans to provide a webpage where you can download the data you want. The data is part of the Ocean Tracking Network and will be available through their system.

It was suggested that the Bedford Basin station data be included in the study of sea level rise. It was noted that this Station is not on the AZMP web site.

The location of the north wall of the Gulf Stream has been used for many years as a response to the North Atlantic Oscillation (NAO). When asked why it wasn't used in this case, two reasons were given: off Nova Scotia there seems to be no significant correlation, and the method of calculating the wall is very subjective. There is also the question of whether the NAO causes the change in position of the north wall or the Gulf Stream moves in response to something else. The speaker noted that the increase in stratification on the Scotian Shelf is caused by water getting fresher at surface.

When asked why Halifax SST is not correlated with air temperature as found in other regions, the speaker replied that Halifax is at the intersection of two water masses and the location of this boundary changes with time. This effect on the local SST outweighs the local effect of air temperature.

State of the Environment – 2011 - Maritimes/Gulf Regions

J. Spry and C. Johnson**

Summary

Mixing and Optics:

- Seasonal progression of stratification was similar to conditions seen previously at both fixed stations; however, summer stratification continued to increase on the Scotian Shelf.
- Photic depths at both fixed stations were shallower than normal in 2011 but the reasons for this difference is not clear, i.e. not consistent with low chlorophyll levels.

Nutrients:

- Nitrate inventories at both fixed stations were lower than normal; summer nutricline depths were deepest on record at HL2.
- Deep nutrient inventories (sections) were generally lower than normal in spring, especially on the eastern shelf.
- However, higher than normal bottom nutrients (HL) and lower oxygen on the eastern shelf in summer/fall indicated the influence of Warm Slope Water (confirmed by T/S properties).

Biological (Phytoplankton):

- Record low chlorophyll levels were observed at both fixed stations; the spring bloom at both stations was smaller, later and of shorter duration than normal.
- However, observations from the sections suggest a strong spring bloom, especially on the eastern shelf, in contrast to results from HL2.
- Background chlorophyll levels (outside of the spring bloom period) at HL2 were higher than seen in the previous few years.

- Phytoplankton community structure was similar to that seen in previous years but abundances were down.
- CPR: phytoplankton indices (2010) were similar or slightly lower than the high values of the 1990s and 2000s and higher than the low values of the 1960s and 1970s; confirm strong spring bloom; indices for the first 3 months in 2011 were similar to 2010.

AZMP Zooplankton - 2011

- Most observations (fixed stations, sections, trawl surveys) suggest that zooplankton biomass and *C. finmarchicus* abundance were lower than normal and could be following a downward trend.
- Community composition was similar to normal at Halifax-2, despite low abundance, and warm water copepods were abundant in fall.
- Total copepods were low in abundance at Prince-5, and the community was dominated by Gulf of Maine / Scotian Shelf and not nearshore species.
- Pattern of low abundance/biomass at fixed stations was also evident on the sections, especially Cabot Strait.

CPR Zooplankton - 2010

- Small copepods and krill were low on the SS in 2010, while *Calanus* anomalies differed on the WSS (-) and ESS (+), similar to ring net survey.
- Changes on the Southern Newfoundland Shelf in 2010 were similar to the ESS.
- Increases in phytoplankton, *Calanus*, small copepods, and hyperiids in the North Atlantic in 2010 may be related to increased Arctic inflow and warming.

Discussion

Comments for C. Johnson: one of the participants asked whether Arctic outflow is inferred from biology in the CPR timeseries or are there measurements? The speaker replied that Erica has inferred it from the biology, based on species composition; it has not been measured quantitatively. It was noted that Eugene estimates geostrophic flow for offshore, but inshore is much more of a challenge.

It was noted that the choice of CPR track makes a difference in how data are interpreted; ships choose the economical route, not the biologically significant route. It was suggested that perhaps a new shipping company could be used. The speaker noted that it is a challenge for SAHFOS to find shipping companies which travel the appropriate routes monthly and are willing to tow the CPR, and the fact that there is not much money to pay the shipping company does not help.

A participant mentioned that John Smith uses isotropic tracers which could indicate Arctic outflow. There are two routes that the Arctic outflow can take; the flow coming through the archipelago would stay closer inshore. Nutrients could also help to measure Arctic outflow. However, the influence of Arctic water on the 40-45 degree North box is still questionable.

One participant asked how robust the measurements of species composition are. The speaker replied that seasonal community variability at each station and the spatial differences among stations are robust, although the total abundance peak magnitude and timing can vary.

Prince 5 and Wolves Samplings (Bay of Fundy)

J.L Martin, M.M. LeGresley, P.M. McCurdy, F.H. Page, J. Fife, K. Pauley and S. Scouten*

Abstract

Temperature and salinity sampling was initiated at Prince 5 in 1924 and continues today as part of AZMP. A phytoplankton monitoring programme was initiated in southwest New Brunswick in 1988 in response to a rapidly growing aquaculture industry and concerns about environmental impacts and harmful algal blooms (HABs). Results from early work in the late 1970s and early 1980s on the paralytic shellfish poisoning (PSP) producing organism, *Alexandrium fundyense*, and its distribution in the Bay of Fundy determined that Prince 5 was not the best indicator site for *A. fundyense* population dynamics studies; sampling at the Wolves Islands gave a better representation of offshore phytoplankton populations and their transport to the inshore regions. As a result, the long term sampling site at the Wolves was initiated in 1988 and has been monitored regularly since.

Sampling at the Wolves site is at weekly intervals between April and late October resulting in 652 total visits from 1988- 2011 whereas at Prince 5 samples are collected monthly resulting in 240 samplings during the same time period. Sampling at the Wolves includes phytoplankton species abundance, nutrients, secchi and CTD casts at the surface, 10m, 25m and 50m; sampling from Prince 5 is at the surface, 10m, 25m, 50m and just above bottom (approximately 90m). Analyses of phytoplankton from the Wolves are from each of the discrete depths every week during bloom periods whereas at Prince 5, 100 ml from each depth is integrated into one sample during the mid-month sampling. Phytoplankton samples are analysed from the Wolves at SABS using the Utermohl settling method and those from Prince 5 are done using the freeze transfer method. As the phytoplankton analysis from the Wolves separates surface samples from those collected at depths, higher numbers are observed of some species that tend to concentrate in the surface layers; however, an integrated sampling may show higher numbers of species such as pennate diatoms that can concentrate in the deeper waters. It does not, however, give a greater indicator of total biomass.

During 2003 and 2004, there was a comparison study done between surface samples collected between the 2 sites. Results from one sampling in 2003 showed 41 species at the Wolves and 19 at Prince 5. *A. fundyense* concentrations in the samples were 84,000 cells•L^{-1} at the Wolves and no *A. fundyense* observed at Prince 5. Another species, *Ditylum brightwellii* had 105,000 cells•L^{-1} at the Wolves and 41,000 cells•L^{-1} at Prince 5. Results from another sampling in 2004 showed 26 species at the Wolves and 20 at Prince 5. *A. fundyense* concentrations in that sample were 299,000 cells•L^{-1} at the Wolves and no *A. fundyense* observed at Prince 5; 89,000 cells•L^{-1} of *Pseudo-nitzschia* spp chains of cells were observed at the Wolves whereas 2400 cells•L^{-1} were detected at Prince 5.

Collection of samples at weekly intervals gives a better indication of peak phytoplankton values as sampling monthly can often result in missed blooms or missing the magnitude of a particular bloom. The same can be said for temperature and nutrient values.

Discussion

A participant asked if an analysis has been done of all sites to relate community structure to environmental conditions using a multivariate approach? The speaker replied that an analysis has been done, and the broad picture shows a switch from diatoms to dinoflagellates, but often this is due to one species driving the change. She also noted that the strong gradient from

inshore to offshore makes comparisons difficult. It makes more sense to compare individual species.

The speaker noted that typically in the Bay of Fundy, the fall diatom bloom is much larger than the spring bloom.

When asked whether both Wolves and Prince 5 are still being sampled, the speaker replied yes, but noted that a comparison of techniques is required; SABS settles 50mls overnight and uses the Utermohl technique with an inverted microscope while BIO uses a smaller volume, the freeze transfer technique and a compound microscope.

One participant noted that in the 1980s *Alexandrium* distribution had very strong patterns. One of the largest abundances is at Wolves, but there is an abundance of zero right next to it. How can this be explained? The speaker replied that cell concentrations can be patchy and sediment type has a big effect. There are more *Alexandrium* cells found over Lunenburg mud (clay) bottom. Passamaquoddy Bay typically has low numbers of *Alexandrium.*

When asked if industry is involved in this work, the speaker stated that salmon aquaculture drove this study in the early years, and there is still a link. The study started with 18 sites, now the aquaculture companies have been trained and they do sampling and analysis of samples looking for harmful algal species when they think there could be issues and harmful effects to fish. They continue to work hand in hand, send samples and consult with personnel at SABS for verification. SABS provides expertise and advice and in turn gets sampling results and additional samples from industry. At one time industry thought that 100,000 cells/l of the paralytic shellfish poisoning organism would harm salmon, but lab studies have shown this is not the case; salmon can tolerate up to 200,000 cells/l - which allows personnel to continue feeding the fish for longer periods. If elevated unsafe numbers are observed, the industry will cease feeding or make a decision to harvest market size fish. Now SABS is working with mussel farms. Preliminary work shows that the offshore suspended mussels in aquaculture operations tend to collect toxins much faster than inshore intertidal mussels, so further studies are needed.

Recent work on the Climate Database

S. Bond

Abstract

During the winter of 2011, an audit of the open access temperature and salinity database, Climate, was conducted in the Maritimes Region. This audit resulted in the identification of a large number of possibly duplicated profiles—over 43 percent of the missions available were not matched with the archive at ISDM. The presentation outlined this issue and discussed possible causes, highlighting the requirement for improved data management.

Discussion

It was noted during the presentation that the Climate db has not been updated since Feb. 2010 because of personnel changes and that recent reorganization in the section should correct this situation.

The monthly data exchange mechanism between ISDM and BIO is referred to as "AFAP" because it uses a format designed in the days of the Atlantic Fisheries Adjustment Program.

The representative from ISDM agrees that the problem with duplicates in Climate was largely caused by a lack of stewardship on both sides (BIO and MEDS – now ISDM). There were problems with missions being renamed and resent from ISDM to Climate without a signal to delete the missions with declassified names. The duplicate check implemented at BIO only looks for duplicates from a same mission ID, so these missions would not be caught by the duplicate check (which looks for duplicates based on mission ID, < 3 km, < 30 min). Another possible cause is that some missions native to BIO and named with native mission numbers were sent to MEDS where they were given national mission numbers and sent back to Climate, resulting in a large number of duplicates.

Participants wondered what the best solution to this problem would be: to try to fix Climate or to scrap it and build something completely new. It was pointed out that Climate was designed to be a database to build "climatologies"—i.e., it would not include profiles too close in time/space (even if not exact duplicates) so as to avoid bias. The decision must be made as to whether Climate should be a "climate" database or an archive of all available data. One participant said that even though it was called "Climate," it is the source for profile data and so should hold all available data for the East Coast (the ISDM archive is difficult to access since it is not online); participants from other regions agreed, saying that Climate was used in NL region in preference to the local or ISDM archive. This important issue must be addressed.

Discussion turned to retrieving data from the AZMP website. It was pointed out that having empty cells for missing data in the csv file causes serious difficulties when data are used with different tools. The best solution would be a numerical equivalent of "NaN." M Ouellet said he would modify this. Another participant said that there should be a warning indicating incomplete datasets, i.e., data were collected but are not yet released. There are currently colour-coded inventory tables available on the website indicating what has been received at fixed stations and sections, but there is no indication of the expected date when data will be available. The representative from ISDM asked participants for a disclaimer paragraph to be added on the website.

Update on the Satellite Data in Light of the Substantial Drift in the MODIS Sensor

C. Caverhill, H. Maass, C. Porter and G. Lazin*

Abstract

The ocean colour datasets maintained by BIO's remote sensing unit have been processed up to the end of 2011 for MODIS and up to the end of 2010 (or end of mission) for SeaWiFS. However, the MODIS chlorophyll estimates are unreliable for 2011 and part of 2010 due to sensor drift. There will be a reprocessing of MODIS ocean colour data this summer, after which all the AZMP composites and statistics for the reprocessing period will be recalculated. MERIS RR Algal-1 bi-weekly composites for the North Atlantic are being created and will be another source of ocean colour data for AZMP. The images will be posted on our website and statistics will also be available. As with MODIS, GEOTIFF format will also be an option. The MERIS mission started in 2002 and is ongoing.

MERIS FR files are being downloaded and catalogued, and several sub-regions now have time series running from May 2008 to present. The Gully was a new region added in 2011.

Both the MODIS SST and the NOAA/MetOp SST datasets are up to date. The Pathfinder 4 km SST data for 2010 will be loaded soon; the full dataset 1981–2010 has been reissued in

netCDF format (previously it was in hdf format) so new routines have to be tested, after which the entire dataset will be reloaded.

The 1 km primary production dataset (1997–2004) is on the website and in GEOTIFF format. The 4 km primary production dataset (1997–2010) will be available during the next fiscal year.

Many website improvements are being made to the development website, and these should be rolled out onto the public website in 2012. The additions include the SeaWiFS 4 km weekly dataset for the expanded region, MERIS RR semi-monthly composites, and anomaly and climatology maps for all products.

The CSA /GRIP funding for "SST and Ocean colour data streams in support of Operational Oceanography" was not renewed for 2011–12. The goal of the project was to provide ocean colour products for all Canadian waters on a scale similar to the SST coverage on http://ogsl.ca/en.html (data available at http://ogsl.ca/en/obs/data.html). For the pilot year (2010–11), we provided two months of 1 km MODIS chl-a for all Canadian waters. Future plans include completing the MODIS dataset and adding 4 km SeaWiFS chl-a and 1 km MERIS chl-a (algal1).

Discussion

The presenter said that Pathfinder SST data are in a new format, so the loading scripts need to be reworked; this should be done by the end of April 2012. It was asked if the two-week averages for the Petrie boxes will still be available. The answer was affirmative; they are now available, and the MODIS / MERIS comparisons have been done. One participant said that the trends in basic signals showed up very well and this product was very good for his needs. Another participant wondered if there would be continuity in the future, or if data gaps were anticipated. The answer was that the expected satellite lifetime is 5 years, so there should be gaps, but the old satellites are still functioning. There was concern expressed that new satellites might not be launched.

The comment was made that the individual passes are often frustrating because they are empty. It was suggested that thumbnails be available that would provide a quick look at the image before it was downloaded. It was also noted that it is important to know how many passes make up the composite images. The speaker replied that it is hard to give information on how many good passes make up a composite. The question was asked about giving "pixel depth" as a way of providing this information.

The question was asked about how good chl estimates are in coastal waters. The speaker replied that MODIS values are not great in coastal areas; MERIS has various products for case-two waters, and the best approach is to use different algorithms for different coastal areas. She added that it is important to have data available for ground-truthing. Finally, it was asked if primary production was going to be recalculated and estimates released for the Petrie boxes; the answer was yes.

(Rapporteur: P. Galbraith)

A Brief Overview of Recent Analytical Methods Used on the AZOMP AR7W and Extended Halifax Lines: Sulphur Hexafluoride (SF_6) and Spectrophotometric pH Measurements

S. Punshon

Abstract

The first half of this presentation concerned the purge and trap, gas chromatographic analytical system that was designed and built at the Bedford Institute of Oceanography to measure the anthropogenic transient tracer sulphur hexafluoride (SF_6). This gas is currently increasing in atmospheric abundance at a rapid and linear rate which makes it extremely useful as a water mass tracer. The advantages and limitations of this method were described and the first profiles of SF_6 and Freon-12, measured in May 2011, were compared.

The second part of the presentation discussed the high precision (± 0.001 pH unit) spectrophotometric method for determining ocean pH that was introduced on the AR7W Line in 2009. This method utilises the ratio of absorbances at 434 and 578 nm in a seawater sample containing a small amount of *m*-cresol purple indicator. Profiles of pH obtained in 2010 and 2011 along the AR7W line were presented.

Discussion

A question was asked regarding SF6 concentration transects and how it was possible to infer the age of equilibrium without knowing the temperature at equilibrium? Was it a ratio to other gases? The answer is simply that in-situ temperature is assumed to not have changed.

A question was asked regarding the storage duration and whether the use of any kind of bottle might lead to degradation and the increase of pH? The answer was that it is best to process samples as soon as possible, but that samples should be stable for weeks in silicon bottles. Ordinary glass bottles were used for a 2010 survey.

It was asked how ubiquitous is SF6? It is used as a seeded tracer of diapycnal mixing rates, and has some commercial uses.

It was asked if cheaper but less precise methods exist. There is a SeaBird sensor, but it is only good to 1200 m and calibration drifts even day-to-day.

SESSION 3

RESEARCH RESULTS ASSOCIATED WITH AZMP

Bedford Basin is Station Zero of the AZMP Halifax Line

W.K.W. Li

Extended Abstract

Annual average anomalies of sea surface temperature in Bedford Basin exhibit strong temporal coherence with anomalies at stations along the AZMP Halifax Line and also with anomalies in the eastern and western Scotian Shelf. Temperature anomalies at the Compass Buoy station in Bedford Basin are correlated with those on the Scotian Shelf. The strength of correlation

decreases with distance from the Basin, from very strong (0.9) at HL2 off Chebucto Head, to moderate (0.5) at HL5 near the shelf edge, to very weak (0.2) at HL8 on the slope. The coherence of multiannual variations in temperature and picophytoplankton abundance observed in the Basin may likewise be expected to occur on the Scotian Shelf as a whole.

Long term trends (multidecadal) in seasonally adjusted values of environmental drivers (e.g. climate), pressures (e.g. temperature), and state (e.g. plankton) are best discerned from records of observation that are both extensive in duration and intensive in frequency. None of the stations on the AZMP Halifax Line provide data that meet these conditions. On the other hand, the Compass Buoy station in Bedford Basin has been monitored on a weekly basis for 20 years. Here, we show coherent long term temperature variations leading out from the Basin to the Shelf, indicating that the Compass Buoy station may be regarded as the inshore terminus of the Halifax Line, with implications for shelf-wide variations of picophytoplankton abundance related to temperature change.

The climatology and deseasonalised multiyear trend of surface temperature in Bedford Basin were calculated and displayed in standard ICES format employed by WGPME (Li et al. 2011). The 3-year running mean indicates that Basin temperature in the first decade of the 21st century was below normal in the first half of the decade, and above normal in the second half. The same pattern in the 3-year running mean of annual average temperature anomalies is seen in the Port of Halifax, at Halifax Line station 2, and across the western and eastern Scotian Shelf. The anomalies at these locations are correlated significantly ($p<0.05$) with those in Bedford Basin ($r = 0.89, 0.85, 0.86, 0.59$ respectively).

Using SST measured by NOAA AVHRR instrument, we calculated climatology and annual average anomalies for a line of 119 virtual stations, starting at 63^{0}26'45.6", ending at 61°23'49.2", positioned apart by about 1.3 minutes longitude, thus creating a highly-resolved inshore-offshore gradient along the actual Halifax Line. For positions on the shelf but not on the slope, the time evolution of the 3-year running mean was similar to that in Bedford Basin. Notably, the correlation coefficient relating anomalies in the Basin with those on the virtual line decreased in a striking manner along the inshore-offshore gradient, becoming statistically not significant ($p>0,05$) near the shelf break (Fig. 1).

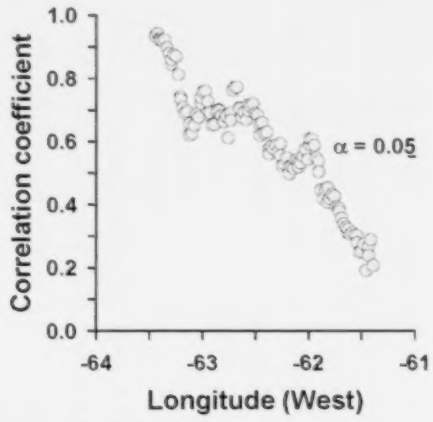

Fig. 1 Decreasing correlation of annual average temperature anomalies between Bedford Basin (63^{0}38'25"W) and positions along the Halifax Line.

In Bedford Basin, there is a strong relation between annual average anomalies of water temperature and picophytoplankton abundance (Fig. 2A), and thus also with mean phytoplankton assemblage size (Fig. 2B). These relationships were earlier noted (Li and Harrison 2008), but the present results of temperature coherence suggest that the picoplankton trend might also be a shelf-wide pattern.

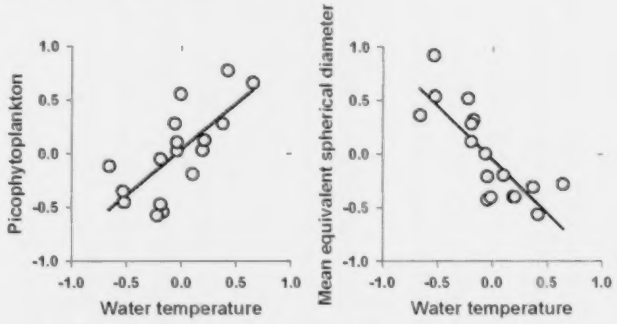

Fig. 2 Correlations between the annual average anomalies for temperature and (A) picophytoplankton abundance, and (B) mean cell size of the phytoplankton assemblage in the Bedford Basin.

ACKNOWLEDGMENTS

Ocean monitoring team: Kevin Pauley, Tim Perry, Jeff Spry, Jeff Anning, Carol Anstey, Marc Ringuette. *Remote sensing team:* Carla Caverhill, Heidi Maass, Cathy Porter, Gordana Lazin.

REFERENCES

Li WKW, Morán XAG, O'Brien TD, WGPME participants 2011. Towards an ecological status report for phytoplankton and microbial plankton in the North Atlantic. ICES-CM-2011/B02

Li, WKW, Harrison WG 2008. Propagation of an atmospheric climate signal to phytoplankton in a small marine basin. Limnology and Oceanography 53(5): 1734-1745

Discussion

It was asked if measurements at Bedford Basin show a specific response or can it be generalized to the shelf? The nutrients regime is not so different in Bedford Basin than at Halifax 2, so similarities are greater than what people might expect.

It was asked if sewage treatment affects measurements. The sewage is dumped on the other side of the Bedford Basin sill; Bedford Basin is not the dumping grounds that people imagine it to be. As a follow-up, it was asked why phytoplankton concentrations increase linearly and track nutrients? No answer recorded.

March 22, 2012 (morning) (Rapporteur: G. Maillet)

Changes in the Phenology of *Calanus finmarchicus* at S27: Potential Causes and Consequences

P. Pepin, G. Maillet, E. Colbourne*

Abstract

Typically, the life cycle of *Calanus finmarchicus* consists of a single cohort that arises following the spring emergence of diapausing individuals who spawn to produce the next generation that develops during the summer and enters diapause prior to the onset of adverse environmental conditions. S27 has serves as a monitoring site from which we have attempted to characterize interannual variations in the seasonal succession of stages. Recently, comprehensive analyses have revealed significant changes in the phenology of late stage copepodites, with increased occurrence of adults in the fall starting ~ 2005, reduced occurrence of adults in winter/spring and indications of some changes in the abundance of younger copepodites. The objectives of the study were to assess if there are significant environmental changes that may have affected changes in the phenology of C. finmarchicus, and determine if changes in the phenology of C. finmarchicus at S27 are apparent throughout the region. We investigated whether the changes were caused by variations in temperature, water mass characteristics or food availability using data from a wide variety of sources derived from AZMP activities. We found [1] that changes in seasonal temperature cycles may have shortened duration of late fall – early winter over AZMP period, [2] that the influx of offshore waters may have increased roughly at the same time as changes in phenology have taken place, and [3] that the decline in duration of spring bloom (1999 – 2011) may be the result of increased grazing or a decline in nutrients and that the duration of the fall bloom has increased since the start of the monitoring programme which may provide better environmental conditions when animals normally enter diapause. Regional analyses revealed [1] that the S27 community appears to be a good index of upstream/shelf population but that it represents the midpoint of a gradient, [2] that there have been significant regional changes in stage composition (2000 – 2011) – which have been stronger in upstream and shelf stations, and [3] that there is evidence of stronger fall cohort (C1 – C3) and increased occurrence of adults (C6) at upstream sites. The consequences of changes in phenology of key zooplankton taxa need to be explored further.

Primary Production around the Grand Banks Area

L. Zhai, P. Pepin, G. Maillet, and T. Platt*

Abstract

The biomass of phytoplankton and carbon assimilation were measured intensively in the NW Atlantic at a coastal station and along oceanic transects extending across the Newfoundland Grand Banks, NE-Newfoundland and Labrador Shelf during 2000-2008. Discrete samples of chlorophyll a (Chl a), in-situ profiles of Chl a fluorescence and phtotosynthetic active radiation (PAR), and simulated-in-situ (SIS) photosynthetic versus irradiance (P-E curves) response using carbon fixation were collected. In this study, we investigate the seasonal and interannual variation in primary productivity and photosynthetic parameters derived from natural phytoplankton assemblages. We contrast our measurements of primary production with model estimates derived from an integrated production algorithm and SeaWiFS ocean colour satellite data. Estimated primary production shows strong spatial, seasonal and inter-annual variations. The results showed relatively good agreement between the production estimated by the

production algorithm method compared with the reference production, which uses in-situ values for the parameters, rather assigned ones. Further work is needed to improve the estimation of reference production and to validate and improve the underwater light fields in the local production model.

SESSION 4 - MATTERS ARISING

- Res Doc, SAR and Bulletin
  - SAR; none for 2012-2013.
  - Bulletin – postpone until 2011 update is available (include 2010-2011).
- Presentations (ftp drop site) email alert created (P. Galbraith) - all regional reports to be placed on site along with synthesis presentations.
- Next zonal meeting; tentatively planned for the week of March 18,

End of Meeting

At 12:05 PM, Session 4 and the AGM concluded with the chair offering his thanks to the participants.

APPENDIX 1 - TERMS OF REFERENCE

Fourteenth Annual Meeting of the Atlantic Zone Monitoring Program (AZMP)

Zonal Peer Review – Quebec, Newfoundland & Labrador, Maritimes and Gulf Regions

March 19-22, 2012
Montreal, QC

Chairperson: Jacques A. Gagné

Context

The Atlantic Zone Monitoring Program (AZMP) was implemented in 1998 with the aim of collecting and analyzing the biological, chemical, and physical field data that are necessary to (1) characterize and understand the causes of oceanic variability at the seasonal, interannual, and decadal scales, (2) provide multidisciplinary data sets that can be used to establish relationships among the biological, chemical, and physical variables, and (3) provide adequate data to support the sound development of ocean activities.

The program sampling strategy is based on (1) seasonal and opportunistic sampling along sections to quantify the oceanographic variability in the Canadian NW Atlantic shelf region, (2) higher-frequency temporal sampling at more accessible fixed sites to monitor the shorter time scale dynamics in representative areas, (3) fish survey and remote sensing data to provide broader spatial coverage and a context to interpret other data, and (4) data from other existing monitoring programs such as CPR (Continuous Plankton Recorder) lines, sea level network, nearshore long-term temperature monitoring, toxic algae monitoring, or from other external organizations (e.g., winds and air temperatures from Environment Canada) to complement AZMP data.

The collected data are edited and archived in databases managed by DFO's Integrated Science Data Management (ISDM) Branch.

Objectives

1. Review the activities of the Atlantic Zone Monitoring Program during 2011 and assess business, operational and logistic issues that need regional/zonal intervention, or that need to be brought to the attention of the DFO Atlantic Science Directors Committee.
2. Synthesize and integrate the biological, chemical and physical oceanographic conditions observed in the Atlantic Zone since 1998, identify trends or changes if they occur, and provide a critical assessment of the information available. Review progresses made since March 2010 and plan work for next year.

Expected publications

- CSAS Research Documents
- CSAS Proceedings

Participants

- DFO Science Branch
- Environment Canada

APPENDIX 2 - AGENDA

14th Annual Meeting of the Atlantic Zone Monitoring Program

20 - 22 March 2012

Hilton Garden Inn Montréal Centre-ville, 380 rue Sherbrooke Ouest, H3A 0B1
Salle James McGill B

Tuesday March 20 PM

Session 1 - AZMP Business Meeting (Rapporteur: B. Casault)

- 13:00 - 13:10: **J.A. Gagné**: Welcome/ introduction. Acceptance of agenda.
- 13:10 - 15:00: Action items from March 2011 meeting.
- 15:00 - 15:20: Break.
- 15:20 - 16:20: **E. Colbourne, L. Devine, J. Spry**: Regional activity reports.
- 16:20 - 16:30: Wrap-up and end of session 1.
- 16:30 - 17:00: PMCC meeting.

Wednesday March 21

Session 2 - Review of physical and biogeochemical environmental conditions in the Northwest Atlantic (Rapporteurs: C. Caverhill and L. Devine)

- 9:00 - 9:20: **E. Colbourne**: Physical oceanographic conditions on the Newfoundland and Labrador Shelves during 2011.
- 9:20 - 9:40: **G. Maillet**: Biogeochemical conditions on the Newfoundland and Labrador Shelves during 2011.
- 9:40 - 10:00: **P. Galbraith**: Physical oceanographic conditions in the Gulf of St. Lawrence in 2011.
- 10:00 - 10:30: **M. Starr and M. Harvey**: Biogeochemical conditions in the Gulf of St. Lawrence during 2011.
- 10:30 - 10:50: Break.
- 10:50 - 11:10: **D. Hebert**: Physical oceanographic and meteorological conditions on the Scotian Shelf and in the Gulf of Maine during 2011.
- 11:10 - 11:30: **J. Spry**: Optical, biogeochemical conditions on the Scotian Shelf and in the Gulf of Maine during 2011.
- 11:30 - 11:50: **B. Greenan**: 2011 physcial, chemical and biological conditions in the Labrador Sea (AZOMP).
- 11:50 - 12:00: Discussion on environmental conditions.
- 12:00 - 13:30: Lunch.

- 13:30 - 13:50: **J. Martin**: P5 and the Wolves.
- 13:50 - 14:10: **S. Bond**: Recent work on the Climate database.
- 14:10 - 14:30: **C. Caverhill**: Update on the satellite data in light of the substantial drift in the MODIS sensor.
- 14:30 - 14:50: **S. Punshon**: Overview of sulphur hexafluoride (SF6) and spectrophotometric pH measurements.
- 14:50 - 15:20: Break.

Session 3 - Research results associated with AZMP (Rapporteur: G. Maillet)

- 15:20 - 15:50: **W. Li**: Recent Bedford Basin results.
- 15:50 - 16:20: **P. Pepin**: Changes in the phenology of *Calanus finmarchicus* and *Pseudocalanus* sp. at S27: investigating possible causes and consequences.
- 16:20 - 16:30: Wrap-up and end of session 3.
- 16:30 - 17:00: PMCC meeting.

Thursday March 22

Session 4 - Integration and synthesis (Rapporteur: G. Maillet)

- 8:30 - 10:30: Integration and synthesis.
- 10:30 - 10:50: Break.

  Res. Docs., Advisory Documents and Bulletin

  Matters arising

  Wrap-up and workplan for 2012-2013

  Next zonal meeting
- 12:00: End of general meeting.
- 12:00 - 13:00: PMCC meeting.

APPENDIX 3 - PARTICIPANT LIST

Name	Affiliation
Bond, Shelley	BIO, Dartmouth
Casault, Benoit	BIO, Dartmouth
Caverhill, Carla	BIO, Dartmouth
Greenan, Blair	BIO, Dartmouth
Hebert, Dave	BIO, Dartmouth
Johnson, Catherine	BIO, Dartmouth
Kennedy, Mary	BIO, Dartmouth
Punshon, Steve	BIO, Dartmouth
Spry, Jeff	BIO, Dartmouth
Chassé, Joël	GFC, Moncton
Devine, Laure	IML, Mont-Joli
Gagné, Jacques A. (chair)	IML, Mont-Joli
Galbraith, Peter	IML, Mont-Joli
Harvey, Michel	IML, Mont-Joli
Lavoie, Diane	IML, Mont-Joli
Starr, Michel	IML, Mont-Joli
Ouellet, Mathieu	ISDM, NCR, Ottawa
Lyon, Paul	NCR, Ottawa
Colbourne, Eugene	NAFC, St. John's
Maillet, Gary	NAFC, St. John's
Pepin, Pierre	NAFC, St. John's
Martin, Jennifer	SABS, St. Andrews